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| 09/749,917 | 12/29/2000 | Christopher C. Chang | 015290-458 | 6832 |

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| EXAMINER | |
|---|---|
| UHLIR, NIKOLAS J | |
| **ART UNIT** | **PAPER NUMBER** |
| 1773 | 12 |

DATE MAILED: 01/27/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

A8-12

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/749,917 | CHANG ET AL. | |
| | Examiner | Art Unit | |
| | Nikolas J. Uhlir | 1773 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *03 September 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-34* is/are pending in the application.

4a) Of the above claim(s) *1-13* is/are withdrawn from consideration.

5)☒ Claim(s) *22 and 23* is/are allowed.

6)☒ Claim(s) *14-21,24-34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *10,12* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

### *Examiners Note*

It has come to the attention of the examiner that the applicants filed an additional amendment that was mailed on October 23, 2002. Unfortunately, this amendment was lost, and never matched with the file. As a result, the examiner submitted a new action on 12/12/02 that did not address the changes incorporated by the non-entered amendment. Accordingly, the action dated 12/12/02 is superceded by this action, which addresses the previously non-entered amendment.

### *Claim Rejections - 35 USC § 112*

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim 27 recites the limitation "the substrate" in the 2nd line of the claim. There is insufficient antecedent basis for this limitation in the claim.

### *Claim Rejections - 35 USC § 102*

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 14-15, 19-20, 26, and 34 are rejected under 35 U.S.C. 102(b) as being anticipated by Ding et al. (EP0845545).

5. Regarding the limitations of claim 14 and 26, wherein the applicant requires a component of a plasma reactor, wherein the component has one or more surfaces

exposed to a plasma during processing, wherein the component comprises an as-sprayed plasma sprayed coating on a plasma exposed surface of the component, wherein the coating has an as-sprayed surface roughness that promotes the adhesion of polymer deposits.

6. Regarding these limitations, Ding et al. teaches a coating for plasma chamber parts, wherein the properties of the coating enhance the adhesion of material which is deposited onto it, such that the deposited material does not flake off of the coating and contaminate substrate that are processed in the chamber (column 3, lines 2-29). The deposition chamber of Ding et al. comprises chamber walls 21, gas inlet 23, exhaust outlet 25, substrate pedestal 27, target 17, and substrate 19 (column 4, lines 22-33 and figure 1). During processing, plasma is generated from a process gas, and particles sputtered from the target 17 deposit on the substrate, the particle screen, and other equipment surfaces (column 4, lines 40-53). These particles are not strongly adhered to the plasma chamber parts, and tend to peel off and contaminate the substrate (column 5, lines 20-36). To alleviate this problem, Ding et al. coats the plasma chamber parts with a plasma sprayed coating having a rough or non-uniform surface, which increases the adhesion of the deposited particles (column 5, line 37-column 6, line 21).

7. Regarding the limitation of claim 1, wherein the applicant requires that the coating promote the adhesion of polymer deposits. Although ding does not specifically teach this limitation, the coating taught by Ding et al. is similar to the coating required by claim 14, in that it is flame sprayed, has a rough surface, and increases the adhesion of particles deposited on its surface. Thus, because of these similarities, the examiner

takes the position that the coating of Ding et al. will meet the requirement of promoting the adhesion of polymer deposits.

8. Regarding the limitations of claim 15, wherein the applicant requires the component to be made from a metallic or a ceramic material. In a specific embodiment, Ding et al. teaches that the coated particle-screening device can be made from materials such as titanium, stainless steel, and copper, which are known metals. Thus, the limitations of claim 15 are met.

9. Regarding the limitations of claims 19 and 20, wherein the applicant requires the coating to be a ceramic or a polymeric material (claim 19), specifically ceramics such as alumina, yttria, zirconia, silicon carbide, silicon nitride, boron carbide, and boron nitride. Ding et al. teaches that the coating composition is plasma sprayed aluminum (column 5, lines 37-56). While the examiner acknowledges that Ding et al. does not specifically teach that the coating formed comprises alumina ($Al_2O_3$), the examiner takes the position that this limitation is met, as it is well known in the art that a thin layer of aluminum oxide ($Al_2O_3$) forms over any aluminum surface, unless special precautions are taken to prevent such oxidation from occurring. Thus, the limitations of claims 19 and 20 are met.

10. Regarding the limitations of claim 34, wherein the applicant requires a component of a plasma reactor having similar requirements as that required by claim 14, with the difference being that the coating is formed by a process consisting essentially of plasma spraying a coating material on a plasma exposed surface of the

component, wherein the coating has an as-sprayed surface roughness that promotes the adhesion of polymer deposits. This limitation is met as set forth above for claim 14.

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. Claims 14-21, 25-29, 31-32 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Richardson et al. (US5916454) in view of Ding et al.

13. Regarding the limitations of claim 14 and 26, wherein the applicant requires a component of a plasma reactor, wherein the component has one or more surfaces exposed to a plasma during processing, wherein the component comprises an as-sprayed plasma sprayed coating on a plasma exposed surface of the component, wherein the coating has an as-sprayed surface roughness that promotes the adhesion of polymer deposits.

14. With respect to these limitations, Richardson et al. teaches a method for reducing byproduct generation in a plasma-processing chamber. The method includes providing a chamber interior part that has a roughness specification designed to promote the adhesion of byproduct particles to its surface (column 2, lines 25-32), specifically polymer particles (column 5, lines 5-11).

15. Richardson et al. fails to teach a coating for a plasma chamber part, wherein the coating has an as-sprayed surface roughness that promotes the adhesion of polymer deposits, as required by claim 14.

16. However, Ding et al. teaches plasma sprayed coatings for plasma chamber parts that increases the adhesion of particles deposited on its surface (column 5, lines 37-56 and column 6, lines 19-21). The coating composition has a rough, non-uniform surface, and is porous. The porosity of the coating relives thermal stress between the chamber part and coating particles which are deposited on the chamber part, thereby increasing the adhesion of the coating particles to the chamber part, and preventing the contamination of substrates processed in the chamber (column 5, line 57-column 6, line 21). In addition, Ding et al. teaches that applying this coating to chamber parts that have been previously roughened improves the adhesion of the coating to the chamber part itself. Further, the coating is conformally applied to the rough surface, as shown in figure 3 (column 40-41 and figure 3)

17. Therefore it would have been obvious to one with ordinary skill in the art to coat the rough plasma chamber parts taught by Richardson et al with the porous coating composition taught by Ding et al.

18. One would have been motivated to make such a modification due to the teaching in Ding et al. that applying a porous plasma sprayed coating to a roughened plasma a chamber part increases the adhesion of materials which are deposited on the coating. One would have been further motivated to make this modification due to the fact that the Ding et al. coating conforms to the rough surface of the plasma chamber parts, thus maintaining the surface roughness of the part, and thus likely retaining the benefits taught by Richardson et al.

19. Regarding the limitations of claims 15 and 16, wherein the applicant requires the component to be made from a metallic or ceramic material (claim 15), specifically a material that has a plasma exposed surface of anodized or unanodized aluminum. Richardson et al. teaches in a specific embodiment that the chamber walls may comprise anodized aluminum (column 3, lines 52-64). Thus, the limitations of claim 16 are met.

20. Regarding the limitations of claim 17, wherein the applicant requires the component to be made from a ceramic material selected from the group consisting of alumina, yttria, zirconia, silicon carbide, silicon nitride, boron carbide, and boron nitride. These limitations are met as set forth above for claims 15 and 16, as anodized aluminum has the formula $Al_2O_3$, which is well known in the art to also be called alumina.

21. Regarding the limitations of claim 18, wherein the applicant wherein the applicant requires the component to be selected from a plasma confinement ring, a focus ring, a pedestal, a chamber wall, a chamber liner, and a gas distribution plate. Richardson et al. teaches that suitable parts of the chamber that may be roughened include the chamber walls (column 6, lines 33-43). Thus, the limitations of claim 18 are met.

22. Regarding the limitations of claims 19 and 20, wherein the applicant requires the coating to be a ceramic or a polymeric material (claim 19), specifically ceramics such as alumina, yttria, zirconia, silicon carbide, silicon nitride, boron carbide, and boron nitride. Ding et al. teaches that the coating composition is plasma sprayed aluminum (column 5, lines 37-56). While the examiner acknowledges that Ding et al. does not specifically

teach that the coating formed comprises alumina ($Al_2O_3$), the examiner takes the position that this limitation is met, as it is well known in the art that aluminum will oxidize to form aluminum oxide ($Al_2O_3$), unless special precautions are taken to prevent such oxidation from occurring. As Ding et al teaches no such precautions, the limitations of claims 19 and 20 are met.

23. Regarding the limitations of claim 21, wherein the applicant requires the componenet and the coating material to be the same ceramic material selected from alumina, yttria, zirconia, silicon carbide, silicon nitride, boron carbide, and boron nitride. Richardson et al. specifically teaches that the wall of the plasma chamber can be formed from anodized aluminum ($Al_2O_3$) (column 3, lines 52-55). Ding et al. teaches that the coating material is plasma sprayed aluminum, which as stated above for claims 19 and 20 will oxidize to form aluminum oxide ($Al_2O_3$) unless special precautions are taken to prevent this oxidation from occurring. As Ding et al. does not teach any oxidation preventative precautions, the examiner takes the position that the plasma sprayed aluminum taught by Ding et al. will oxidize to form aluminum oxide ($Al_2O_3$). As a result, both the component and the coating will be formed of the same material. Thus, the limitations of claim 21 are met.

24. Regarding the limitations of claim 25, wherein the applicant requires the coating to have a roughness value between 150-190 micro inches. Richardson et al. discloses that plasma reactor components are typically manufactured to maximize their smoothness, because this allows for a tight seal with other parts, easy cleaning, and low moisture absorption. However, this leads to increased particle contamination (column 5,

lines19-35). The amount of particle contamination is reduced by roughening the surface of a chamber component, thereby increasing the adherence of byproduct particles to the component surface (column 5, lines 43-48). Thus, the examiner takes the position that the surface roughness of a plasma reactor interior component is a results effective variable. One would roughen the surface to improve byproduct adhesion, and one would smooth the surface to promote easy cleaning and low moisture absorption. Therefore, it would have been obvious to one with ordinary skill in the art at the time the invention was made to optimize the roughness of the interior components to the range specified in order to achieve the desired balance between increasing the adhesion of byproduct particles and seal, cleaning, and moisture absorption properties.

25. Regarding the limitations of claim 26, wherein the applicant requires a plasma reactor having a component according to claim 26. This limitation is met as asset forth above for claim 14 above.

26. Regarding the limitations of claim 27, wherein the applicant requires a method for processing a substrate in a plasma reactor according to claim 26, wherein the method comprises exposing a surface of the substrate with a plasma. Richardson et al. teaches exposing the surface of a substrate to a plasma (column 4, lines 35-52). Thus, the limitations of claim 27 are met by the combination of Richardson et al. with Ding et al.

27. Regarding the limitations of claim 28, wherein the applicant requires a method for processing a substrate in a plasma chamber, the method comprising positioning the substrate onto a substrate support in the reactor; introducing a process gas into the reactor; applying RF energy to the process gas to generate a plasma adjacent an

exposed surface of the substrate; and etching the exposed surface of the substrate. Richardson teaches a method for processing a substrate comprising all of the required steps of claim 28 in column 4, lines 35-53). Thus, the limitations of claim 28 are met by the combination of Richardson et al. and Ding et al.

28. Regarding the limitations of claim 29, wherein the applicant requires the process gas to comprise at least one polymer forming species. Richardson et al. teaches a specific process gas that forms carbon-based polymers when the gas is used in a processing chamber (column 5, lines 1-11). Thus, the limitations of claim 29 are met.

29. Regarding the limitations of claim 31, wherein the applicant requires the process gas to be introduced into the chamber via the openings in a gas distribution plate. Richardson et al. teaches that the process gas is introduced through a gas injection port, which is a ring shaped manifold having a plurality of holes for releasing gaseous source materials (column 3, line 65-column 4, line 5). It is the examiners position that this ring shaped manifold is equivalent to the applicants claimed gas distribution plate. Thus, the limitations of claim 31 are met.

30. Regarding the limitations of claim 32, wherein the applicant requires the component to be a ceramic material. Richardson et al. teaches that the interior surfaces of the chamber can be manufactured from materials such as ceramics and or plastics (column 7, lines 59-67). Therefore it would have been obvious to one with ordinary skill in the art at the time the invention was made to manufacture the interior parts from ceramics due to the teaching in Richardson et al. of the equivalence of ceramics to other materials suitable for manufacturing chamber parts.

31. Regarding the limitations of claim 33, wherein the applicant requires the coating to be formed form a polymeric material. The examiner acknowledges that neither Richardson et al. nor Ding et al. specifically teaches this requirement. However, Ding et al. specifically teaches that the coating material is adventitiously formed to be similar, if not identical to the material that is deposited on it. I.e. if aluminum is deposited, the coating is flame sprayed aluminum (column 5, lines 50-55 of Ding et al.). By doing this, the differences between the coefficient of thermal expansion of the coating and the deposited material can be reduced, thereby increasing particle adhesion (column 5, line 50-column 6, line 9). Richardson et al. teaches an embodiment wherein a certain process gas results in the deposition of carbon based polymers on the surface of the plasma chamber parts (column 5, lines 1-11 of Richardson et al.).

32. Therefore it would have been obvious to one with ordinary skill in the art at the time to utilize a plasma sprayed polymer coating on the rough surfaced plasma chamber part taught by Richardson et al.

33. One would have been motivated to utilize polymeric material as the coating material taught by in this particular situation due to the fact that the deposited material of Richardson is a polymer material, and the fact that Ding et al. specifically teaches the coating should be similar or identical to the material that is expected to be deposited on it in order to reduce the effects of thermal stress between the deposited material and the coating, thereby increasing the adhesion of the deposited material.

34. Regarding the limitations of claim 34, these limitations are met as set forth above for claim 14.

35. Regarding the limitations of claims 35-39, these limitations are met as set forth above for claims 14, 17, 25 and 34 above.

36. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Richardson et al. as modified by Ding et al. as applied to claim 14 above, and further in view of Shih et al. (US6120640)

37. Richardson et al. as modified by Ding et al. does not teach a coating that has a thickness between 2-5mils or 5-10mils, as required by claims 22 and 24 respectively.

38. However, Shih et al. teaches plasma sprayed boron carbide coatings for plasma chamber parts (column 5, lines 15-21 and column 7, lines 20-30). This coating is formed to provide increased durability to the plasma-exposed surfaces of interior components in plasma reactors (column 5, lines 14-15). Specifically, these coatings are applied to surfaces of plasma chamber parts that are formed from anodized aluminum that has been roughened prior to coating (column 5, lines 33-42). The thickness of the boron carbide coating is typically between 5-10mils (column 8, lines 20-21).

39. Therefore it would have been obvious to one with ordinary skill in the art to use the 5-10mil thick plasma sprayed boron carbide coating taught by Shih et al. as the coating material for the plasma chamber parts taught by Richardson et al. as modified by Ding et al.

40. One would have been motivated to make this modification due to the teaching in Shih et al. that plasma coating the surface of aluminum oxide based plasma chamber parts with a layer of boron carbide improves the corrosion resistance of the parts when they are used in etching processes. One would have been further motivated to make

this modification due to the fact that the parts of Richardson et al. as modified by Ding et al. are form from anodized aluminum which has been roughened, which is the ideal substrate for the boron carbide coating taught by Shih et al.

### *Allowable Subject Matter*

41. Claims 23 and 24 are allowed.

42. The following is a statement of reasons for the indication of allowable subject matter: While the plasma deposition of polymer materials such as polyimide is known, as shown by EP0546802 (Beals et al.). However, there is no motivation in the prior art to coat a plasma exposed part of a plasma processing chamber with such a coating. Further, even if there were motivation to coat a plasma chamber part with a plasma sprayed coating, there is no teaching in the prior art that doing so would result in a coating that improves the adhesion of polymer deposits, as required by the instant claims. Accordingly, the examiner deems claims 23 and 24 to be allowable over the prior art.

### *Response to Arguments*

43. Applicant's arguments with respect to claims 14-34 have been considered but are moot in view of the new ground(s) of rejection.

### *Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nikolas J. Uhlir whose telephone number is 703-305-0179. The examiner can normally be reached on Mon-Fri 7:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Thibodeau can be reached on 703-308-2367. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-0389.

nju
January 14, 2003

STEVAN A. RESAN
PRIMARY EXAMINER